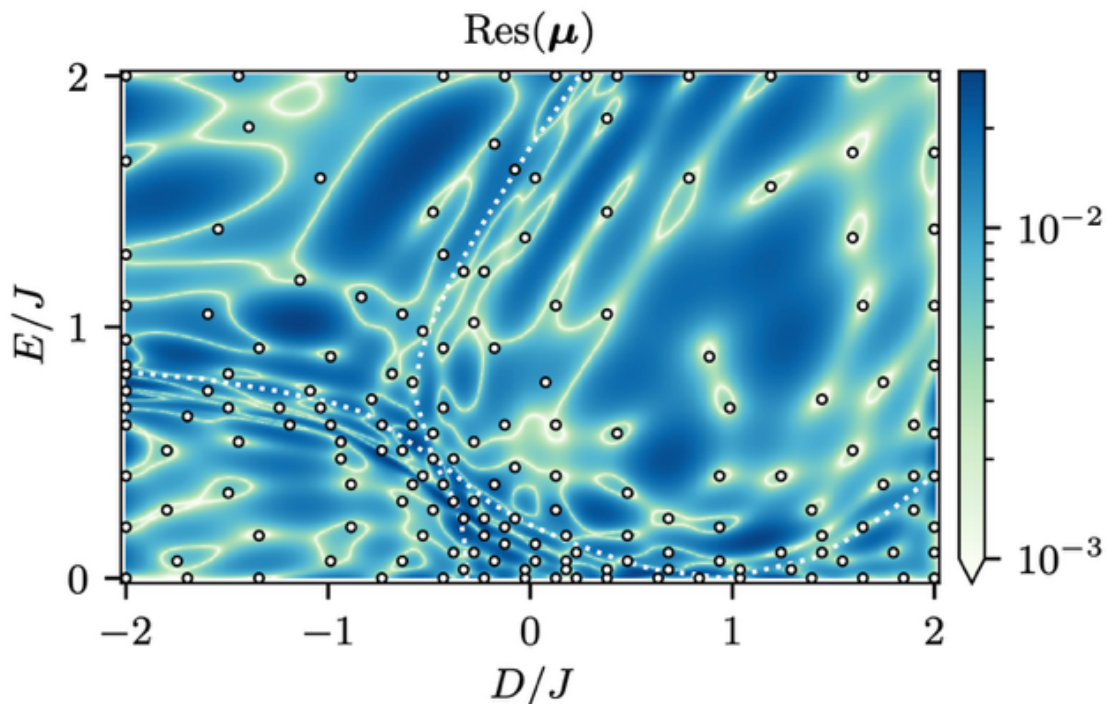




Reduced basis surrogates for quantum many-body systems using tensor networks

Prof. Dr. Stefan Wessel

RWTH Aachen



One of the primary challenges in quantum many-body theory is identifying phase diagrams of strongly interacting quantum systems, given the exponential growth of the many-body Hilbert space dimension. The reduced basis modeling approach tackles this by constructing an effective low-dimensional subspace of the total Hilbert space to explore ground-state phase diagrams, utilizing solutions of snapshots—specific ground states corresponding to well-chosen parameter values. We demonstrate how to implement a greedy strategy using tensor network states to assemble this reduced basis and select parameter points. Once the reduced basis is established, computing observables necessary for phase diagrams becomes feasible with a complexity independent of the underlying Hilbert space for any parameter value. The efficiency and accuracy of this method are exemplified through studies of one-dimensional quantum spin models, including those with anisotropic and biquadratic exchange interactions, revealing diverse and intricate quantum phase diagrams.